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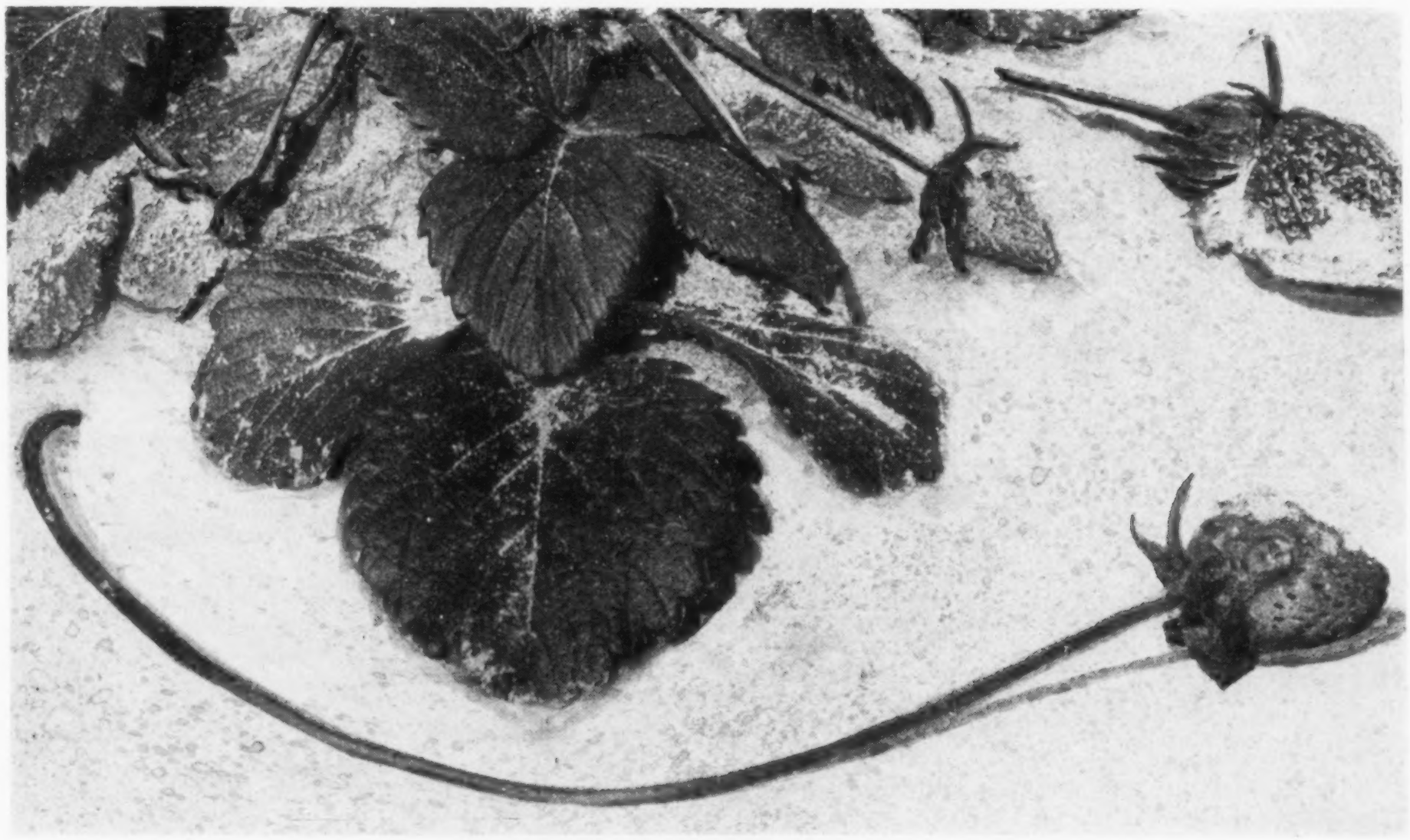

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NOVEMBER, 1926 Vol. 17, No. 11

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The

Journal of Heredity

VOL. XVII, No. 11 November, 1926

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The JOURNAL OF HEREDITY is published monthly by the
AMERICAN GENETIC ASSOCIATION

At 1918-32 Harford Avenue, Baltimore, Md., and
Victor Building, Washington, D. C.

Address communications regarding editorial matters and the business management of the Association to Room 306, Victor Building, Washington, D. C.

Entered as second class matter February 24, 1923, at the post office at Baltimore, Maryland. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized December 20, 1918. **Contents copyrighted 1927 by the American Genetic Association. Reproduction of articles or parts of articles permitted only upon request, for a proper purpose, and provided due credit is given to the author and to the JOURNAL OF HEREDITY, Washington, D. C.**

Date of Issue of this number, January 15, 1927

$3.50 a Year; 35c the Copy

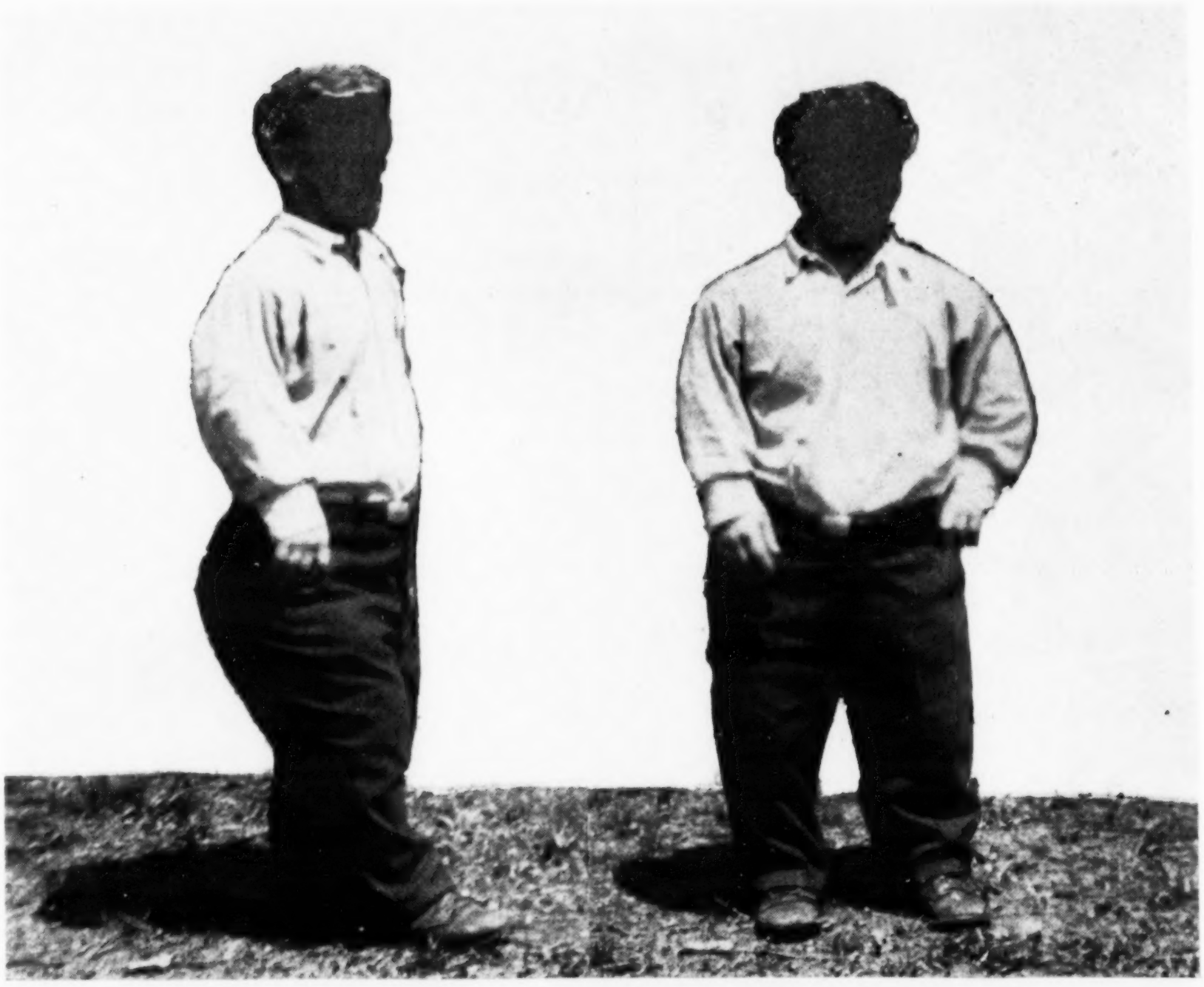
TWO TYPES OF DWARFS

Frontispiece

Dwarfs are of two kinds: In one type (Ateliosis) the bodily proportions are normal or infantile; in the other (achrondroplasia) the head and trunk are of nearly adult proportions—the limbs being very short. The dwarfs shown here chiefly illustrate ateliosis, with probably one example of achondroplasia, (The large-featured dwarf at the upper left). The mode of inheritance of dwarfism is still obscure, but in some cases it is certainly hereditary as in the family here reported in which achondroplasic dwarfs occur in four generations.

SEVERAL GENERATIONS OF ACHONDROPLASIA

JOHN S. BANGSON
Berea College



AN ACHONDROPLASIC DWARF

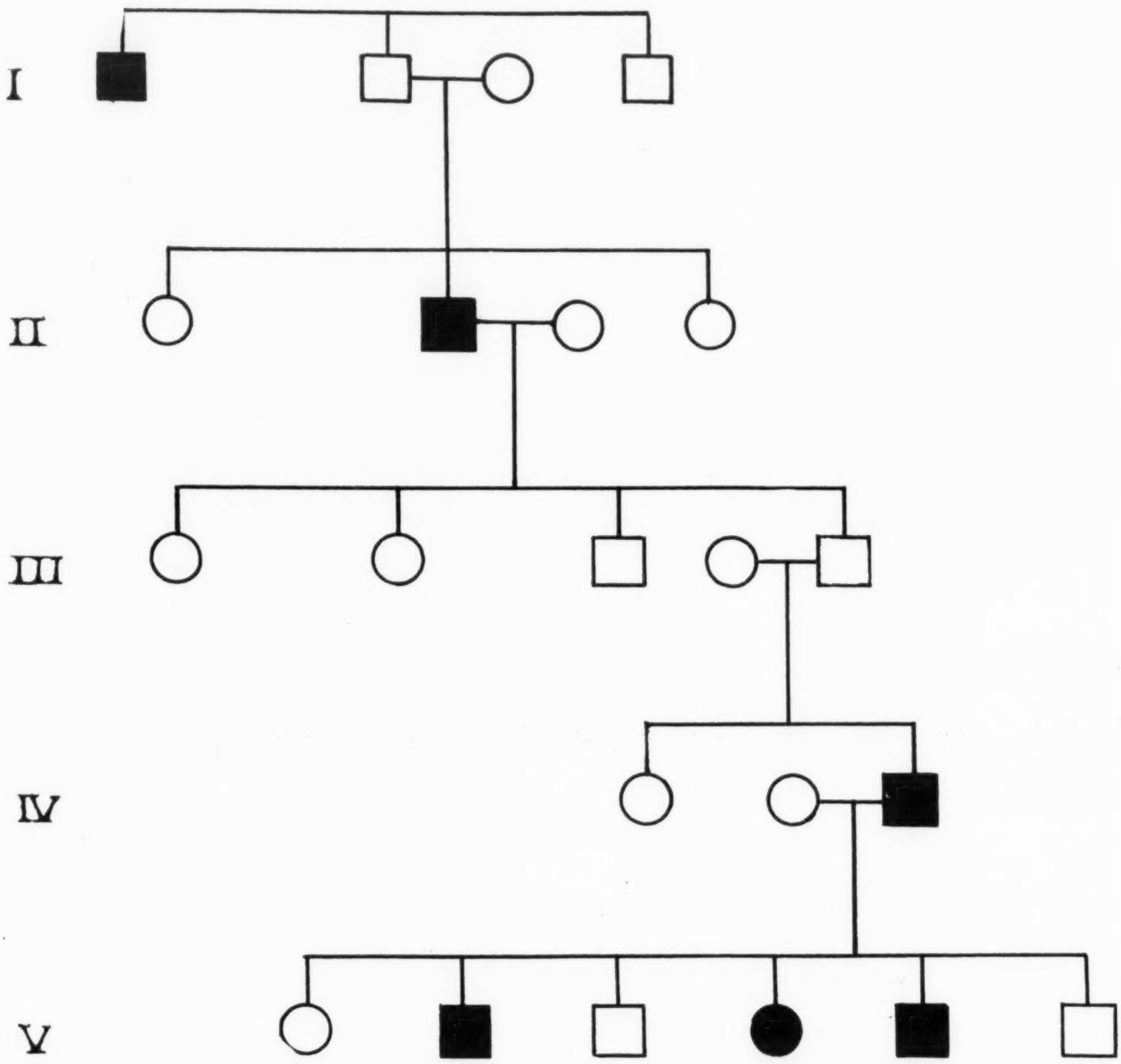
Figure 1

Two views of the young man whose history is discussed in the accompanying article. He has a brother and a sister who are also dwarfs, and three normal sibs. The trait has been traced in this family for five generations.

THERE are two types of human dwarfism. Ateliosis, or true dwarfism, is the result of arrested "development before it is complete," the result of a premature cessation of growth, producing tiny miniature individuals, and due, perhaps, to irregularities in the functioning of the thyroid and the thymus glands.

The second type, achondroplasic dwarfism, or achondroplasia, includes individuals with extremely short legs, while their bodies are generally normal in their proportions. It is due to a defect in the formation of cartilage "at the epiphyses on the ends of the long bones."

Recently an individual of the latter catagory attracted the attention of the writer, and it was thought advisable to inquire into his family history. Following is the story; the facts contained were secured from and vouched for by the father of the above individual. His source of information was the old family records.



INHERITANCE OF ACHONDROPLASIA

Figure 2

Generation I. shows the three brothers who came from Scotland to Virginia. One of them was a dwarf. The trait was transmitted by one of the normal brothers to his son and to his great grandson. Nothing is known about the descendents of the other two brothers.

The history of this interesting family in America begins with three brothers who, in the early days, came from Scotland to Virginia. Of the three, one was a dwarf.

One of the normal men married a normal woman, and to them three children were born, two normal daughters and a dwarf son. This latter to a normal woman was father of four children, two daughters and two sons, all normal. The second son, the fourth child, was a man six feet tall and weighted one hundred fifty-five pounds.

This tall man married a normal woman, and of their two children, a daughter and a son, the daughter was normal, while the son was a dwarf, the man from whom these data were secured. He describes himself as "a small or short man, exceedingly stout and active." He says of his wife that she "is a normal woman whose average weight is one hundred forty pounds."

They have six children, two daughters and four sons. Of these, one-half, a daughter and two sons, are normal, while a daughter and two sons are dwarfs. The oldest child, a daughter, died in infancy. The second, a son, now twenty-one, in the words of his father "is an exact reproduction of his father." The third child, a normal son, "holds the record as the fastest runner of one hundred yards for the Seventh Congressional District of Georgia." The fourth child, a daughter, and the fifth, a son, are short like their older dwarf brother, while the father says the sixth, a son, "is very much like his long legged brother the runner."

Nothing is known of this character relative to the descendants of the other two brothers who came from Scotland with the progenitor of the above line.

As yet authorities do not agree as to the mode of inheritance of achondroplasia. Gates, 1923, states that "the condition may appear accidentally, or it may be hereditary."

It is realized that this meager bit of evidence of itself is of small worth, but it is given with the hope that together with others of the same nature one of the problems of genetics may eventually be solved.

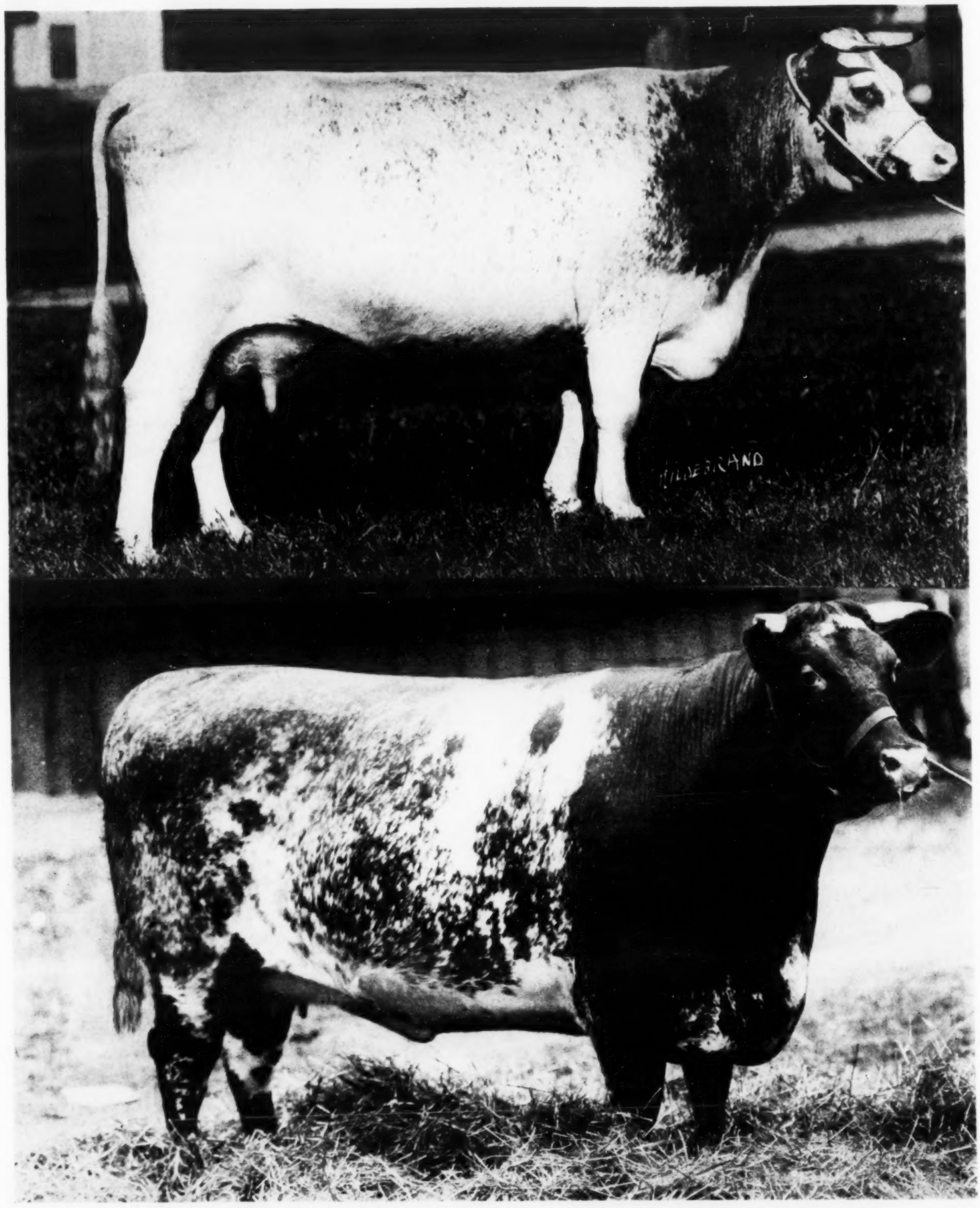
"The Rat" Revised

THE RAT, Data and Reference Tables for the Albino Rat (*Mus norvegicus albinus*) and the Norway Rat (*Mus norvegicus*), by HENRY H. DONALDSON. Second edition. Revised. Pp. XIV + 469. Memoirs of the Wistar Institute of Anatomy and Biology. Philadelphia. 1924.

"The Rat," the first edition of which appeared in 1915, is a book which is indispensable to any one conducting researches with either the wild grey rat or its tame albino variety. The present edition contains 212 tables, 72 charts and a bibliography of well over 2,000 titles intended to include all available papers recording anatomical investigations and physiological studies. The tables give average measurements and weights of organs at all ages, chemical composition of parts, data on all vital statistics, etc. Significant points are discussed briefly in the text.

In spite of the enormous number of figures given in the tables, very few are individual measurements. For the most part, they are averages, each the representative of a large number of individual measurements. Next to the average, the most important statistics required to give the essence of a body of data is some measure of the variability. The standard deviation and coefficient of variation supply this need for many important measurements in the present compilation. The average and one of these measurements of variation usually, although by no means always, give a sufficiently accurate picture of the situation with respect to a single measurement considered by itself. An integrated picture of a system of variables requires, however, that the amounts of correlated variability be specified. This is done in only a few cases in the present work. One must not quarrel, however, with Dr. Donaldson and his co-workers for not having extended the statistics given. Those who are working with the rat should be thankful that some one has boiled down such an enormous body of data in so convenient a form.

Sewall Wright.



MILKING TYPE AND BEEF TYPES COMPARED

Figure 3

The milking type shorthorn cow Rosa 4th, 632863 is shown above. Cows of this type possess the potentialities for high milk and butterfat production as well as for beef production. The beef shorthorn cow Lady Dorothy (imp.) 526415 represents a type in which the beef characteristics predominate, while milk production is scarcely sufficient for the calf. It appears from this study that the milking Shorthorns do not represent a special group. Factors for high milk production are widely disseminated in the breed, and selection for milk production has consisted in picking out promising animals wherever they have appeared.

MENDELIAN ANALYSIS OF THE PURE BREEDS OF LIVESTOCK

IV. The British Dairy Shorthorns

HUGH C. MCPHEE and SEWALL WRIGHT

Bureau of Animal Industry, United States Department of Agriculture

THE merits of the Milking Shorthorn is a subject which is much in the foreground today. It has seemed, therefore, that a study of its relation to the Shorthorn breed as a whole as regards foundation stock and system of breeding would be of interest.

The Shorthorn cow with a good milk-production record is not a twentieth century discovery. Individual cases have cropped out all the way back through the history of the breed, but for several reasons these have escaped widespread notice. The time has now come, however, when the dual-purpose type is being exploited extensively by breeders in all parts of the world. There are several reasons for this increasing popularity. First of all, there are well-organized societies in various countries whose purpose it is to promote the interests of the breed and publish records of milk production. Prior to 1905 the absence of such fostering agencies was probably responsible for much of the slow progress made by the individual breeders of the milking type of the beef animal. Prejudice in favor of the strictly beef type probably has had an immense influence in retarding the development of the milking type. Such favoritism is still widespread among many breeders, but it is being found that the dual-purpose cow has a place in economic agriculture.

Breed history shows that milk production was favored by some of the early breeders and discriminated against by others. Thomas Bates gave considerable attention to the milking abilities of his cows and was one of the first to devote study to butter fat production. The Booth cattle, on the other hand, were noted for "a tendency to dry off quickly and put on a great wealth of flesh." Milk production was considered a valuable trait by Amos Cruickshank when selecting foundation cows for his herd, but his later operations were directed towards the development of a rugged beef type. It is this type which predominates in the breed today.

With the organization of the Dairy Shorthorn Societies came the compilation of milk records. In the case of the British Dairy Shorthorn Association, a separate herdbook is not published, the pedigrees of all British Dairy Shorthorns being recorded in Coates' Herdbooks. The production records are published in a separate yearbook. The requirements for eligibility are registration in Coates' Herdbook and either a certificate of merit in milking trials or a certain 365-day milk production, the amount of which varies with the age of the cow. The British Dairy Shorthorns are, therefore, a group of animals selected for milk production from the stock registered in Coates' Herdbooks.

In previous papers of this series[3,4,5] it has not been possible to study milk production because of the absence of milk records for that part of the history in which the studies were pursued. It is the purpose of the present paper to fill in this gap by making a study of the ancestry of the British Dairy Shorthorns and correlating with milk production the degree of inbreeding and

relation to famous foundation sires. The British Dairy Shorthorns were selected because previous studies have been made on the British Shorthorns as a whole, making and direct comparisons possible.

Method

The plan of the present investigation has been to select at random 100 cows from the list published in volume 6 of the Register of the British Dairy Shorthorn Association. Also the 100 highest producing cows were selected from the same volume. These two groups were selected for the purpose of testing whether there is a difference in the inbreeding, relation to Champion of England and relation to Favourite shown by the average producers and that shown by the highest producers. The method of calculating the coefficients of inbreeding and relationship have been presented in previous papers[3,4,5] and need not be discussed in detail here. A single random line of ancestry has been traced back of both sire and dam of each cow to the foundation animals of the breed. From these ancestral lines have been calculated the coefficients of inbreeding, and of relationship between the cows and the famous foundation sires, Favourite and Champion of England.

The average milk production of the two groups of cows has been corrected for age of animal and length of lactation period by the method used by Pearl[1] for dairy cattle. The uncorrected and corrected figures for milk production are given in Table I. The high producers exceed the average producers by almost 4,600 pounds, the average for the 200 cows being 9,407 pounds.

Average Inbreeding

The difference between the average coefficients of inbreeding of the two groups is 1.1 ± 2.8 per cent. Such a difference is not statistically significant, as it is well within the limits of error of sampling. The average coefficient of inbreeding for the 200 cows is 27.5 ± 1.4 per cent. Previously[6] it has been found that the average coefficient of inbreeding for the 1920 British Shorthorns was 26.0 ± 2.0. In view of the size of the probable error, the difference of 1.5 ± 2.4 between the inbreeding of the Dairy Shorthorns and the average inbreeding of the entire British Shorthorn breed is not significant.

Comparison of the dairy type and the whole breed as regards degree of inbreeding is of importance as an indication of the breeding methods which have been used in developing the Dairy Shorthorns. The similarity in degree of inbreeding shown by the dairy group and that shown by the entire breed in 1920 means that there has not been a widespread effort to inbreed among Dairy Shorthorns. In past years, animals with exceptional ability to produce both beef and milk have appeared in various families of the breed. These families have not been more closely related than the average relationship between random animals of the breed. The result has been the selection on the basis of milk production of animals which, as far as inbreeding is concerned, are essentially a random selection from the breed. Doubtless considerable inbreeding has occurred in various individual herds, but on the average the closeness of breeding has been essentially the same as the average for the entire breed. This method differs much from that followed by some of the famous breeders of the foundation stock of the breed. These master breeders selected the best available stock from the relatively small number then existent and by the judicious use of inbreeding brought about remarkable improvement. At the same time the average inbreeding of the breed increased very rapidly. A similar condition would have resulted had the Dairy Shorthorns of today been developed from a few foundation animals and had it been the desire of breeders to develop milk production at the expense of beef. But apparently a very large number of

lines of the breed have contributed foundation animals for the dairy type. Inbreeding would have to be very widespread to raise appreciably the average coefficient of inbreeding above that of the breed as a whole. Furthermore, it is not the purpose of breeders to extract a dairy cow from the beef breed, but rather to breed cows which can use their energy in producing large amounts of milk and still be able to fatten quickly into a high-brade carcass. Apparently the breeders of the dairy type have, on the whole, avoided the extensive use of incestuous matings and have corrected the faults in their cattle by crossing with unrelated stock which possessed the desired characteristics.

Relationship To Favourite

Because of the high relationship which has existed between the Shorthorn breed and the famous Colling bull, Favourite, since the year 1825, it is important to study the relationship which exists between this sire and the Dairy Shorthorns. As already stated in a previous paper[6] the relationship of the Shorthorn breed to Favourite was slightly greater than 50 per cent in 1825 and has remained practically at this level ever since. In 1920 it was 55.2 ± 2.3 per cent. The relationship to Favourite shown by the 100 high-producing Dairy Shorthorns was 55.7 ± 2.4 per cent and that shown by the random producers was 56.6 ± 2.3 per cent. The average relation to Favourite shown by the 200 cows was 56.1 ± 1.6 per cent. The difference between this figure and 55.2 ± 2.3 per cent for the breed in 1920 is only 0.9 ± 2.8 per cent, and cannot be considered of any significance. This result confirms the statement made in a previous paper[6] that Favourite blood has become so uniformly diffused throughout the breed that no further change is possible.

Relationship To Champion of England

There is somewhat of a tendency among modern breeders of Shorthorn cattle to draw a rather sharp line of distinction as regards blood lines between the beef and dairy types of the breed. This tendency has been strengthened undoubtedly by the fact that some of the best modern beef animals trace back to the Scotch foundation stock, while some of the highest-producing animals of the dual-purpose type trace back to the Bates stock. It might be supposed that the beef type would show a higher relation to Champion of England than would the dairy type. The figures obtained in the present study, however, give only a slight indication that such a condition exists. The average coefficient of relationship between the 200 cows and Champion of England was 42.1 ± 1.6. The difference between this figure and 45.5 ± 2.3 for the Shorthorn breed in 1920 amounts to only 3.4 ± 2.7 per cent. In view of the large probable error it is unsafe to attach any significance to this difference. In tracing back random lines of ancestry of a Dairy Shorthorn cow, about the same proportion trace to Champion of England as in the case of a Shorthorn cow selected at random without regard to milk production. This means that relationship to Champion of England and milk production of the modern Dairy Shorthorns are not correlated to any appreciable extent. There is no doubt that certain Scotch-bred families are low in milk production and probably it is also true that there are many Bates-bred families which are just as low. A beef-type Shorthorn is not necessarily closely related to Champion of England and a milking-type Shorthorn is not necessarily closely related to the Bates-bred stock. In this connection it must not be forgotten that Champion of England had an infusion of Belvedere and 2d Hubback blood and thus a modern animal might trace back to the Bates stock through Champion of England.

Homogeneity

The best measure of the homogeneity of the Milking Shorthorns is the

average coefficient of relationship between the cows which make up the group. This is essentially the coefficient of correlation with respect to characters determined wholly by heredity with no dominance[2,5,6]. In the present case such average coefficients of relationship have been obtained for the Milking Shorthorns *inter se* and between the Milking Shorthorns and a random selection from the whole breed.

The degree of relationship within the entire Shorthorn breed in 1920, which is used as a basis of comparison with the present group[6], is 39.5 $\pm$3.2.

The average relationship among the 100 high-producing cows in the present study came out 41.7$\pm$2.4 per cent, and that between the random milk producers 37.8$\pm$2.4 per cent. Such a result shows that the two groups do not differ appreciably with respect to average relationship *inter se,* the difference being only 3.9$\pm$3.4 per cent. In comparing with the breed of 1920 it is found that the average relationship *inter se* for the 200 Dairy Shorthorns is almost identical with the corresponding figure for the breed in 1920. The 100 high-producing cows are 2.0 per cent higher and the random producers are 1.7 per cent lower than the breed average for 1920. Both of these differences are less than their respective probable errors and are therefore well within the limits of the error of sampling. One of the most important figures to determine is the relationship between dairy Shorthorns and random Shorthorns. It happens that both the high-producing and random dairy Shorthorns are related practically as closely to random Shorthorns (38.0$\pm$1.7 and 37.6$\pm$1.7) as random Shorthorns are to each other (39.5$\pm$3.2). The strongest indication of concentration of blood lines is in the difference of 3.7$\pm$2.9 per cent by which high producers are more related to each other than to the random Shorthorns, but this indication is at best only slight. It is clear that the dairy Shorthorn group is based on as great a diversity of blood lines as a random sample of the breed.

Summary

In the present study an attempt has been made by the use of coefficients of inbreeding and relationship to ascertain the methods used in developing the British Dairy Shorthorns. The development of the modern Dairy Shorthorns practically began in the year 1905, with the organization of the British Dairy Shorthorn Association. About this time foundation animals were selected for their dairy qualities from a large number of different sections of the breed.

Close inbreeding has been avoided to such an extent that on the average the modern British Dairy Shorthorn does not differ in this respect from the entire British Shorthorn breed of 1920. Likewise, the average coefficients of relationship between the Dairy Shorthorns and the two foundation sires, Champion of England and Favourite, do not differ significantly from the coefficients of relationship between these sires and the Shorthorn breed of 1920.

It has been found that the average relationship of the Milking Shorthorn cows to each other *or even to random animals of the whole Shorthorn breed* does not differ significantly from the average relationship between random Shorthorns. The British Dairy Shorthorns are, therefore, a group selected for dairy qualities from such diverse blood lines as to be equivalent to a random selection from the Shorthorn breed as regards degree of inbreeding, relationship to Champion of England and Favourite, and relationship *inter se*. The figures indicate a very wide if not wholly random distribution of the genetic potentialities for high milk production throughout the whole Shorthorn breed.

As regards degree of relationship to Champion of England and Favourite, the figures indicate that both the entire Shorthorn breed and the Dairy Shorthorns probably will remain substantially constant in this respect even

though the Dairy Shorthorns separate entirely from the rest of the breed. A slight but gradual rise may be expected in degree of inbreeding and relationship *inter se*. Such a rise should be more rapid in the smaller Dairy Shorthorn section where there is still the chance for important animals to play a role similar to that of Champion of England in the breed as a whole.

TABLE I. Average milk production, coefficients of inbreeding, and coefficients of relationship between two groups of Dairy Short-horns and Champion of England and Favourite, with the 1920 breed average for comparison

No. of Animals	Average corrected milk production* lbs.	Inbreeding	Relationship			
			Inter se	to Favourite	to Champion of England	to entire breed
100	11,701	26.9±2.0	41.7±2.4	55.7±2.4	41.2±2.3	38.0±1.7
100	7,113	28.0±1.9	37.8±2.4	56.6±2.3	42.7±2.3	37.6±1.7
Average	9,407	27.5±1.4	39.7±1.8	56.1±1.6	42.1±1.6	37.8±1.2
Breed (1920)	.....	26.0±2.0	39.5±3.2	55.2±2.3	45.5±2 3	39.5±3.2

*The average uncorrected milk yields were 11,868 for the high producers and 6,874 for the random producers.

Literature Cited

1. Pearl, Raymond. 1915. Reports of Progress of Animal Husbandry Investigations in 1915. *Paper No.* 92 from the Biological Laboratory of the Maine Agricultural Experiment Station.

2. Wright, S. 1922. Coefficients of Inbreeding and Relationship. *Amer. Nat.*, 56: 330-339.

3. ————————. 1923. Mendelian Analysis of the Pure Breeds of Livestock. I. The Measurement of Inbreeding and Relationship. *Journal of Heredity*, 14:339-348.

4. ————————. 1923. Mendelian Analysis of the Pure Breeds of Livestock. II. The Duchess Family of Shorthorns as Bred by Thomas Bates. *Journal of Heredity*, 14:405-422.

5. ————————, and Hugh C. McPhee. 1925. An Approximate Method of Calculating Coefficients of Inbreeding and Relationship from Livestock Pedigrees. *Jour. Agri. Research*, XXXI, No. 4, 377-383.

6. McPhee, Hugh C. and Sewall Wright, 1925. Mendelian Analysis of the Pure Breeds of Livestock. III. The Shorthorns. *Journal of Heredity*, 16:205-215.

The Flowers of Florida

Florida Wild Flowers, *by* Mary Francis Baker, Price $3.00. The Macmillan Co., 1926.

This untechnical handbook of seven hundred of the more common species of Florida flowering plants should be welcome to visitors and residents. The veriest novice may easily manipulate the key, based upon flower color and leaf arrangement, and so gain a speaking acquaintance with the rich and varied flora. The interest is enhanced by a number of good illustrations and by data as to the uses of the native plants both today and among the Indians in earlier times.

The author says, "The great diversity of soils in Florida, often in a limited area, gives rise to a remarkable variety in the flora. From high pineland to marsh, and from sandy shore to swamp, each change in the character of the soil is shown in the different plant associations." Semi-tropical plants along the southern coasts give place to typically northern species along the northern shores. The marshland flora is especially rich in curious forms, notably of insect-catching plants which number more than twenty species, and air plants and orchids which make the swamps and hammocks of southern Florida "hanging gardens of beauty."

The user of the handbook need never be idle, for "from January onward throughout the entire year during an ordinary season the variety of flowers continually increases." A. C. C.

AN ODD CHESTNUT MUTATION

Figure 4

The mutant is shown at the right, a normal branch at the left. The burr of the normal chestnut has given way in the mutant to a peculiar form of fruit in which the "chestnuts" are attached to the outside of a faceted receptacle. Two of these fruits are shown opposite the lower burrs on the normal branch. In all other respects the mutant plant is normal.

A MUTATION IN THE CHESTNUT

Castanea Crenata

RAMON BLANCO
Director of the Agronomical Section,
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FOUR years ago I sowed at the Agricultural Experimental Grounds in Lugo some fruits of the Japanese Chestnut *Castanea crenata* which had come directly from Japan. I remember exactly that all the fruits sown were of the same size, all were normal and similar in shape and general appearance within the natural fluctuations to be observed in any fair sample. I calculate that nearly 80 per cent of the plants did not germinate or died soon after germination.

The surviving plants are now growing at the nursery and are botanically all alike, *except one.* All have also started to set fruit in the same year. The exceptional plant differs then from its neighbors only in regard to its fruits. To show better the case it will be well to consider first the usual fructification of the Japanese chestnut-tree and then compare it with that shown by the exceptional plant.

Since it is very difficult to distinguish the japanese chestnut *Castanea crenata* from our native form *Castanea vesca,* it will not be necessary to say that the fruits are very much alike in both species.

The fruit is compound, or aggregate; it is formed by the floral bracts which become thornlike and coriaceous and inclose a certain number, differing from flower to flower, of akenia, which are commonly called chestnuts.

It should not be forgotten that with more or less correctness the name cupula is given to several fruit-structures such as those of the chestnut, hazelnut, etc.

Striking differences are observed in the fruit of *C. crenata* which I present here. The receptacle has been hypertrophied and bears on its surface several polygonal-triangular, trapezoidal, pentagonal, etc.,—facets in which are inserted the akenia.

The bracts which in the normal type form the spriny covering of the fruit are absolutely lacking. The akenia are much smaller in size but more numerous than those of the normal spiny fruits.

The seed coats remain entirely normal: the pericarp, the testa and the endoplevra, also the endosperm shows its normal constitution, as well as its color and taste, notwithstanding the small size of the fruits.

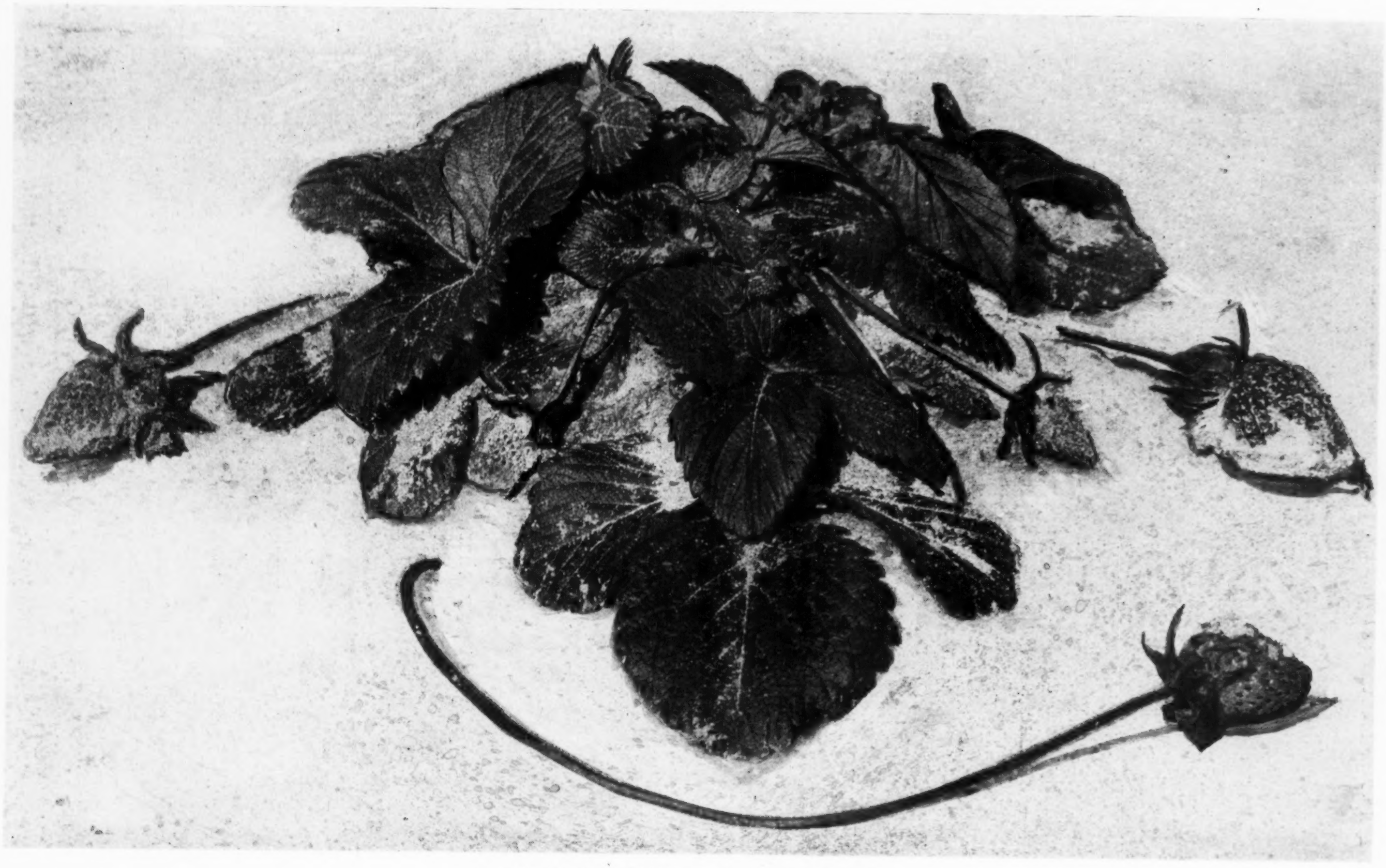
The plants of this new type of *C. crenata* do not offer any other difference from the rest of the plants in the nursery: they are all alike in color, height, shape, leaves, stem, and flowers. The flowering season—to which special attention was given by me—was also the same for all the trees, including the mutant.

The abrupt transition from one form of fructification to the other shows once more that the living beings may vary *by sudden jumps,* without following a gradual, progressive or regressive course. We are therefore in possession of the first and necessary facts which characterize a mutation.

It remains now to investigate whether we are in the presence of a true mutation and as such of an hereditary character, or whether we have to deal with a so-called somatic mutation.

In order to elucidate the question it will be necessary to see whether the new form reproduces by seed or has to be propagated by grafts.

The appearance of its mutation may be appreciated by reference to Figure 4. To the left is shown the normal fruit of the chestnut, at the right the new type of fructification. I call it a new type because I have not found that it has been described before.



LONG STEMMED STRAWBERRIES

Figure 4

A curious sport of the Missionary variety of strawberry in Florida. Several plants in one row had these excessively long fruit stems as though a sport had occurred previous to setting the plants for fruiting; most of the runner plants of this sport then being set close together. There is, of course, the possibility that this was a seedling, yet it is rare to find seedlings surviving in Florida and no such characteristic has ever been noted by this observer. Abnormally long flower stems are a physiological response to certain environmental conditions in the winter but none approach the length of the one shown here.—*George M. Darrow.*

HERITABLE CHARACTERS OF MAIZE

XXVIII—Barren-Sterile*

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As pointed out by Emerson[1] at least nine types of maize have been found in which the normal expression of monoeciousness has been upset. The inheritance of some of these types has been worked out and the genes responsible for them have been located on chromosomes with respect to genes for other characters of the corn plant. Reproductive activity is thus seen to have a distinctly genetic interpretation. A normal corn plant, therefore, bearing a normal tassel and a normal ear is thought of as possessing in its genotypic constitution, all the normal allelomorphs of the genes responsible for abnormal reproductive behavior.

As a result of studies on self-fertilization of corn conducted at the University of Illinois, a type was found which exhibits an extreme expression of the sexual nature of the plant. It is perhaps more proper to speak of it as an "inhibition," rather than as an "expression," of sex, since neither tassel nor ear is produced. The type is both barren and sterile (Figure 5). For this reason the name "barren-sterile" is proposed for it. It differs from "male sterile" found by Eyster[2] in bearing no tassel at all; and it differs from an ordinary barren plant in having no ear though shank and husks are present. Sometimes a very short stubby cob is found and a few silks, but in the majority of cases both cob and silks are absent. It therefore, also differs from the silkless type found by Jones[3] in having no cob. Barren-sterile plants occurring in selfed lines are much weaker and shorter, and the stalks more slender than normal plants in the same lines; but in crosses between certain of these lines, barren-steriles have appeared that exhibited as much vegetative vigor as any of the normals. Plants exhibiting this type of sterility are very susceptible to corn smut; and the root system is very weak or poorly developed.

A few lines throwing the barren-steriles have come from the Illinois High-Yield strain and others have come from a strain of Reid Yellow Dent corn, designated as Funk's 176A. Both these strains are good and have given good results in variety yield tests on the Agronomy South Farm.

In inheritance, barren-sterile behaves as a simple Mendelian recessive. Several plants of the above mentioned varieties, on self-fertilization, gave progenies that segregated in approximately a ratio of 3 normal to 1 barren-sterile. The data are given in Table I. For the totals of Table I, the expected results are 340 normal to 113 barren-sterile. The actual results thus show a deviation of 22 from expectation, with a probable error of ± 3.54. For this character pair the symbols *Bs bs* are suggested.

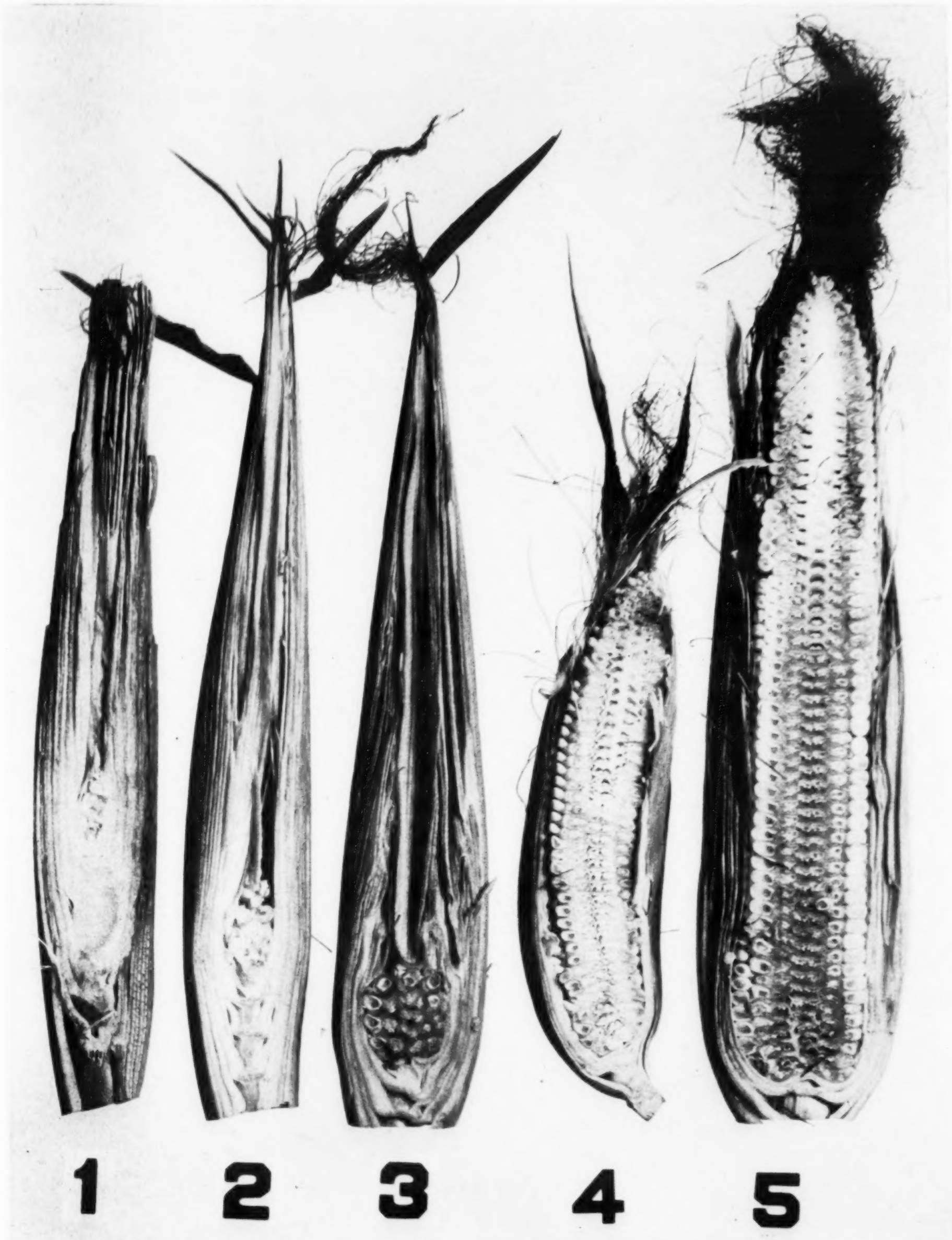
Several normal plants in many of these progenies were selfed and progenies grown. The distribution of the normal and barren-sterile plants in the progenies that showed segregation is given in Table II. The expected results for the totals are 431 normal to 144 barren-sterile. The actual results thus show a deviation of 33 from expectation, with a probable error of ± 4.71.

*Contribution from the Division of Plant Breeding, Department of Agronomy, University of Illinois. Published with the approval of the Director of the Station.

NORMAL AND BARREN-STERILE PLANTS

Figure 5

The barren-sterile plant shows no tassel. Shoots are present but no cobs and no silks. This barren-sterile plant shows more vegetative vigor than most of them because it is one of a progeny obtained by crossing heterozygous plants belonging to different lines segregating for this type of sterility. Since barren-sterile plants do not ordinarily produce seed, the character can only be perpetuated through heterozygous plants.



FIVE EAR TYPES OBTAINED IN THE HYBRID PROGENIES

Figure 6

(1) Just a vestige of a cob bearing four or five silks. In the typical barren-sterile shoot, neither cob nor silks are found. (2) A little larger cob bearing more silks than in (1). (3) A still larger cob than shown in (2). (4) An intermediate type approaching the normal in size of ear. (5) Normal ear.

THREE TASSEL TYPES OBTAINED IN HYBRID PROGENIES

Figure 7

Normal tassel at right. In center, a much reduced tassel consisting of only a shortened central stem. At left is shown a tassel stem which bears no flowers whatever.

FIVE OTHER TASSEL TYPES FOUND IN HYBRID PROGENIES

Figure 8

(1) Tassel stem absent. This condition is typical of the barren-sterile type. (2) A very short branch in addition to the much shortened central stem. Very few flowers. (3) Same as (2) except both branch and central stem are longer and bear more flowers. (4) Approaching the normal in number and length of branches but still much reduced. (5) A large normal tassel. The central stem has been broken down, and thus appears shorter than it really is.

TABLE I—Distribution of barren-sterile and normal plants in the original segregating progenies.

Variety	Parent No.	Progeny No.	Classification of Progeny		Dev./P.E.
			Normal	Barren Sterile	
Funk's 176A	192-15	1369	29	8	.563
	192-17	1370	28	8	.570
	192-25	1273	29	9	—
	192-29	1371	25	9	.587
	197-27	1373	23	14	2.814
Ill. High-Yield	306-11	1433	52	8	3.095
	326-4	1436	50	14	.856
	533-1	1457	69	8	4.292
	533-2	1458	57	13	1.637
Totals			362	91	3.539

TABLE II—Distribution of barren-sterile and normal plants in segregating progenies descended from the original progenies.

Parent No.	Prog. No.	Classification of Progeny		Dev./ P. E.
		Normal	Barren Sterile	
1273-9	1687	47	4	4.314
1370-3	1688	24	9	.596
1373-20	1690	44	11	1.385
1433-2	2293	26	1	3.952
-8	2294	11	2	.950
-21	2295	21	10	1.230
-39	2296	46	10	1.830
1436-16	2298	19	1	3.063
-20	2299	7	3	1.082
-21	2300	26	5	1.845
-26	2301	47	16	—
-38	2302	29	5	1.762
1457-7	2304	16	1	2.492
-16	2307	12	5	.830
-20	2308	15	9	2.096
-30	2309	21	3	2.096
1687-9	2311	37	12	—
-31	2313	16	4	.766
Totals		464	111	4.712

In addition to the segregating progenies, 7 others were grown that bred true for normality. Hence, of 25 progenies tested, 18 segregated and 7 bred true. These results deviate only slightly from the theoretical, based on an expected ratio of 1 non-segregating to 2 segregating progenies.

The high deviations from expectation shown by the totals in Tables I and II are significant. However, an examination of individual progenies in these tables reveals the fact that only one in Table I and two in Table II deviate significantly from expected results if 3.2 or more times the P. E. be taken as a measure of significance. Moreover, segregating progenies 2304, 2307, 2308, 2309 (Table II), coming from the only progeny (1457) in Table I that showed a significant deviation from a 3:1 ratio, gave deviations that were insignificant statistically. Many progenies gave results that closely approached the theoretical; in other progenies, the recessive exceeded the expected number; and in still others, the barren-sterile type was deficient. In view of these facts, it is difficult to account for the variable ratios obtained. However, aside from the wide ratios there is no evidence that would justify a different interpretation from the simple one suggested; and the breeding behavior of normal plants from segregating progenies is wholly in its favor.

While the characteristics of the barren-sterile type appearing in these progenies were the same, and the same gene was apparently responsible in all cases as indicated by the results of crosses, yet, in a few hybrid progenies, plants were obtained that exhibited various degrees of intermediacy between the normal and barren-sterile types. With respect to tassel development the number and length of the branches varied from none in the case of the typical barren-sterile type, to several branches that were about half the length of those on normal plants (Figures 7 and 8). The number of flowers on these intermediate tassel types was much less than on the normal, and the amount of pollen produced was correspondingly less. Similar variation in ear production was found (Figure 6). In some cases there was only a vestige of a cob with a very few silks; in other cases the cobs were larger with a corresponding increase in the number of silks. Furthermore, there were various combinations of tassel and silk development. There were (1) no tassel, no silks—the typical barren-sterile type; (2) normal tassel, no ear —a "barren" type; (3) no tassel, few silks; (4) small tassel, few silks; and (5) normal tassel, few silks. In view of the appearance of these intermediate types in the hybrids it would seem that the inheritance of the barren-sterile condition is, after all, more complicated than is indicated by the simple 3:1 ratio obtained. Studies on the inheritance of this character are being continued.

Literature Cited

1. Emerson, R. A. A genetic view of sex expression in the flowering plants. *Science* 59:176-182. 1924.

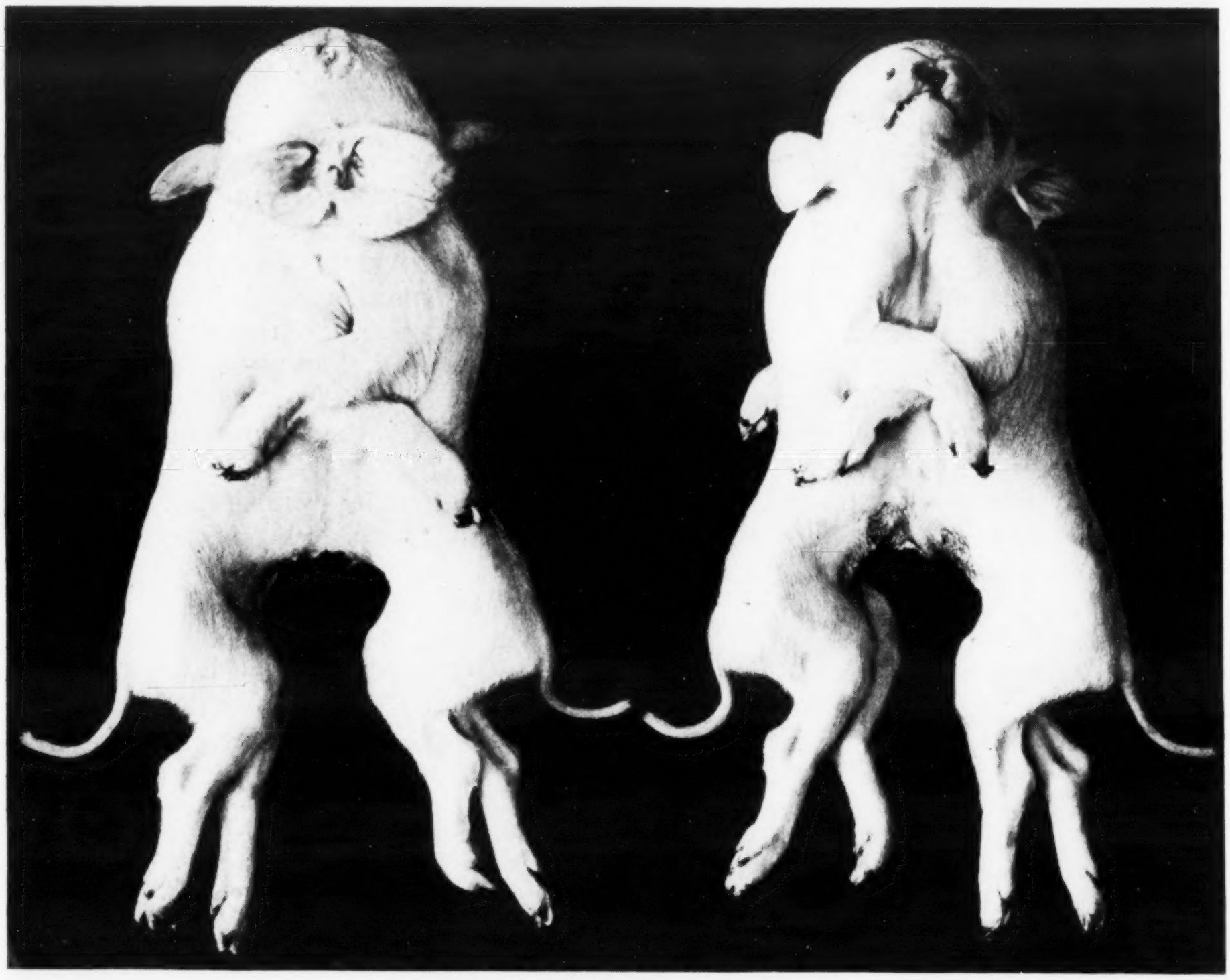
2. Eyster, W. H. Heritable characters of maize: 7—Male sterile. *Journal of Heredity* 12:138-141. 1921.

3. Jones, D. F. Heritable characters of maize: 23—Silkless. *Journal of Heredity* 16:339-341. 1925.

Partial Twinning in Pigs

ON March 28th, 1925, a thirteen months old purebred Yorkshire Sow farrowed a litter of pigs in which there were five normal individuals and one freak. The accompanying photographs were taken a few hours after the monster was born. The two views show opposite sides of the pig (or pair of pigs).

So nearly complete (externally)



ALMOST IDENTICAL TWINS
Figure 9

Monsters of this type are believed to be cases of identical twins in which the two individuals have not completely separated.

were the two members of this pair that it would almost seem that cutting them apart would result in two completely developed pigs. Either member was fully as large as any of its normal litter mates. There were also sufficient parts visible to make two individuals, with the exception of the lower jaw and tongue. In these two structures, however, there was no indication of duplication.

An X-ray photograph, while not as clear as would have been desirable, probably due to the cartilagenous nature of the bones in so young an animal, gave decided indications that the two skulls and breast bones were fused. It also suggested a common throat. The latter was further borne out by an inspection of the mouth of the specimen.

Since it was not wished to open the bodies, no information was obtainable as to the distribution of the various internal structures other than bone. It would appear, however, that, with the exception of the mouth and throat parts, there were two complete sets of structures, though the two skulls were somewhat misshapen along the sections which were grown together.

Both members were female in sex.

This case is apparently an instance of a partial division of a single egg or embryo. Had the division been complete duplicate (or identical) twins would have been formed.

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METAPHANIC VARIATIONS IN ROSE SEPALS

Inter-Organ Hybrids between Leaf and Calyx— Significance of Such Variations in Study of Evolution and Heredity

O. F. Cook
Bureau of Plant Industry

THE study of heredity has revealed a world of new facts and relations that are impossible to describe without extending our vocabulary. The subject-matter of heredity is different from any that the mind of man has dealt with in the past. In these newly explored regions the paths of thought have not been opened or set with words in convenient places, to mark the distinctions that are necessary.

The word "metaphanic" was chosen to convey the sense of changed expression of characters, where characters appear outside of their usual position or sequence in development, or in combinations with other characters that normally are distinct, but sometimes are confused or united in expression. Metaphanic variations are those that show such modified or intermediate expressions of characters. Leaf and calyx, for example, are normally distinct and contrasted in their characters, but when intermediate organs occur, as sepals showing characters of leaves, they may be described as metaphanic variations.

Many variations may be considered as metaphanic, though only a few have been recognized and studied from the standpoint of the expression relations of the characters, as distinguished from other types or classes of variations. No word that is shorter or more familiar than metaphanic has been found to convey the idea of modified expression of characters.

Many of the metaphanic variations are plainly abnormal, as when abortive organs are formed which are intermediate between petals and stamens, or between carpels and leaves, but other metaphanic variations may not interfere with reproduction, as in the present examples of intermediates between the foliage leaves of roses and the sepals.

Several examples of metaphanic variation in cotton and other plants have been noted in previous publications.* The cotton plant shows many intermediate stages between the foliage leaves and the involucral bracts and also stages between the involucral bracts and the divisions of the calyx.

The illustrations of rose sepals now offered may render the subject of metaphanic variation more intelligible. The material was obtained in December, 1924, at Shafter, California, and some of the most striking cases are shown in the natural-size photographs reproduced in Figures 10 and 11.

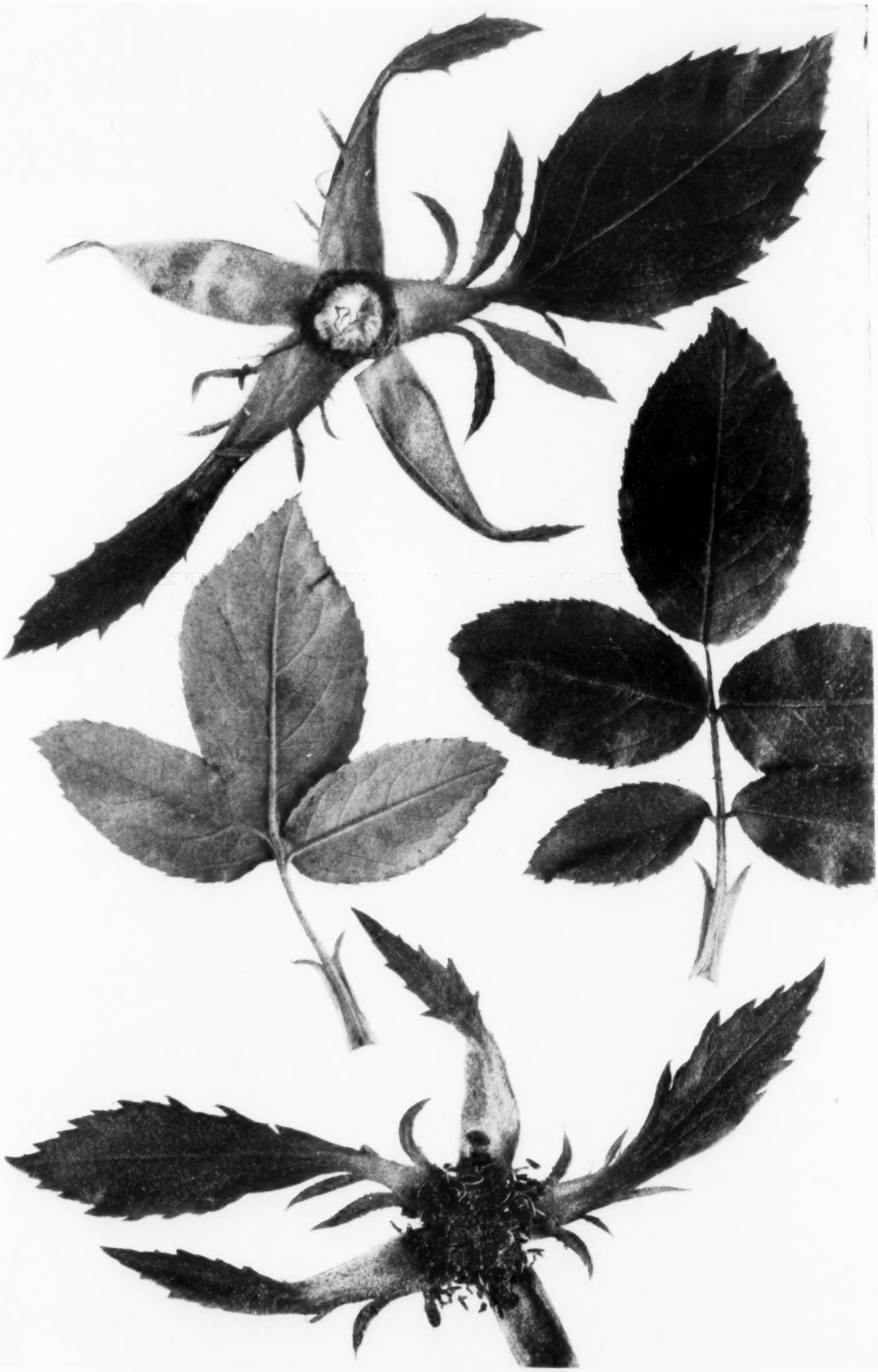
Under the late-season conditions several varieties of roses showed a tendency to foliar enlargement of the calyx, in forms intermediate between foliage leaves and normal sepals. The variations might be described as phyllody of the calyx, though the abnormalities seem less than in the so-called "green roses" where the petals are replaced by more or less leaf-like organs. Unfortunately, notes were not kept of the varieties from which the photographs were taken, but similar

*See Brachysm, a Hereditary Deformity of Cotton and Other Plants, *Journal of Agricultural Research*, 3:387, February 15, 1915. Diversity of Internode Individuals, *Journal of Heredity*, 13:323, July, 1922. Compound Leaves in Walnuts and Hickories, Evolution of *Journal of Heredity*, 14:77, May, 1923.

METAPHANIC ROSE SEPALS

Figure 10

Showing intermediate expression of characters, with leaf-characters and calyx characters combined in the same organs. The largest metaphanic sepals are larger than the first leaves below the calyx, as shown in Figure 11. Intermediate stages between stipules and pinnae of compound leaves are shown in the metaphanic sepals. The numbers show the phyllotaxy of the sepals (see page 417). (Natural size.)



TRANSITION FROM LEAF TO CALYX

Figure 11

The two leaves are from the same stem, immediately below a metaphanic calyx, showing that the usual reduction in the size of the leaves below the flower had not taken place, or only to a slight extent, under the conditions that induced the metaphanic variations. Examples of gradual reduction of leaves may be seen in Figure 4. (Natural size.)

variations occurred in several standard varieties, including American Beauty, which is believed to have contributed most of the specimens that were studied.

Considered as products of abnormal development, these metaphanic sepals may be ascribed to delay or postponement of the changes of characters that occur between leaves and sepals. Reductions in the size of the leaves that occur normally in advance of the formation of the calyx are deferred to the stage of formation of the sepals, so that characters of leaves are shown in different degrees in the modified sepals. In the normal calyx the sepals are much smaller and more nearly equal, and the uppermost leaf below the calyx in some varieties is reduced to a simple bract, often quite similar to the sepals. A series of such bracts, reduced to the size and nearly to the form of the normal stipules is shown at the top of Figure 13.

Leaves that appear in the next position below a normal calyx usually are much more reduced and simplified than the leaves shown in Figure 11. In that position the leaves should have been much more reduced, and in form more like the metaphanic sepals. Thus the leaves in Figure 11, while not abnormal in form, yet were abnormal in their positions at the next node below the calyx.

Hybrids Between Metamers

Metaphanic variations may be considered as hybrids between different kinds of metamers of which the normal plant body is composed. Each plant may be analyzed into a series of different types of internode individuals, or metamers, as formed in the successive stages of the normal life history. The types of metamers show many contrasting characters, and the transitions from one type to another may be very abrupt. The first metamers of plants, represented by the so-called cotyledons or seed-leaves, usually are very different from the next following metamers. Also the floral envelopes are different from the foliage leaves, as well as from the essential organs of the flower.

In rare cases metamers with intermediate characters occur, instead of the normally contrasted metamers, and these are reckoned as metaphanic variations. Some of them could be described very well as interorgan hybrids, if the word *interorgan* were not so easily confused with *interorganic*, thus leading to ambiguity. The word interorganic would suggest the idea of combinations between different organisms, which would be very misleading.

Metamerism in Plants and Animals

The principle of metaphany appears more prominently in plants than in animals on account of the nature of the plant body, which is built of a succession of structural units, the internode individuals, or metamers. While the bodies of animals are also segmented or metamerous, the methods of development are not the same as in plants. In all of the higher types of animal life the metamers are formed in the early embryonic stages, and the whole body develops together, instead of increasing by a gradual addition of newly-formed metamers. Thus a simultaneous metamerism in animals may be contrasted with a successive metamerism of plants.

From the nature of the plant body it is plain that the same radical distinctions are not to be maintained between somatic tissues and germ-plasm as have been inferred from the study of animals. Or if the distinctions are assumed theoretically, it must at least be admitted that the relations of the soma and the germ plasm are different. Since the plant metamers are derived one from another by vegetative propagation, it is more obvious with plants than with animals that the differences of successive metamers are differences in the expression of the characters, rather than differences of transmission.

The metamers are morphological equivalents of each other, and may be

formed in long series of closely similar individuals, or may show successions of strikingly different types of metamers, with or without intermediate forms. The size and form of a plant are determined largely by the number of vegetative metamers, which may be controlled to a great extent by the conditions of growth. Thus the characters of a particular plant are determined not only by the content of heredity transmitted through the seed, but may be modified greatly during the course of development. The conditions of existence may vary so much as to interfere with the normal sequence of expression of the characters of the different classes of internode individuals and the plant may be unable to attain a complete development of the different types of metamers.

The higher animals are much less exposed to environmental interference in development, or to observation of the succession of characters in the stages of development. Many of the lower animals are as obviously metamerous as plants, like the worms, millipeds and centipeds, and such groups may afford cases of approximation of characters in different parts of the body, as in plants. In the centiped genus Newportia, for example, the last pair of legs is very slender and many-jointed like the antennae, and the same might be said of the delicate, closely articulated extremities of all of the legs in another family of centipeds, the Scutigeridae.

Sepals Reduced in Regular Sequence

As examples of metaphanic variation the abnormal rose sepals afford material for study in detail. Even among the sepals of the same calyx, the differences are not to be taken as merely arbitrary or chance variations, but show successive stages of reduction and transformation of the characters. Probably these stages correspond to a process that occurs normally in changing the characters from those of the expanded form of the foliage leaves to the simplified and reduced form of the sepals.

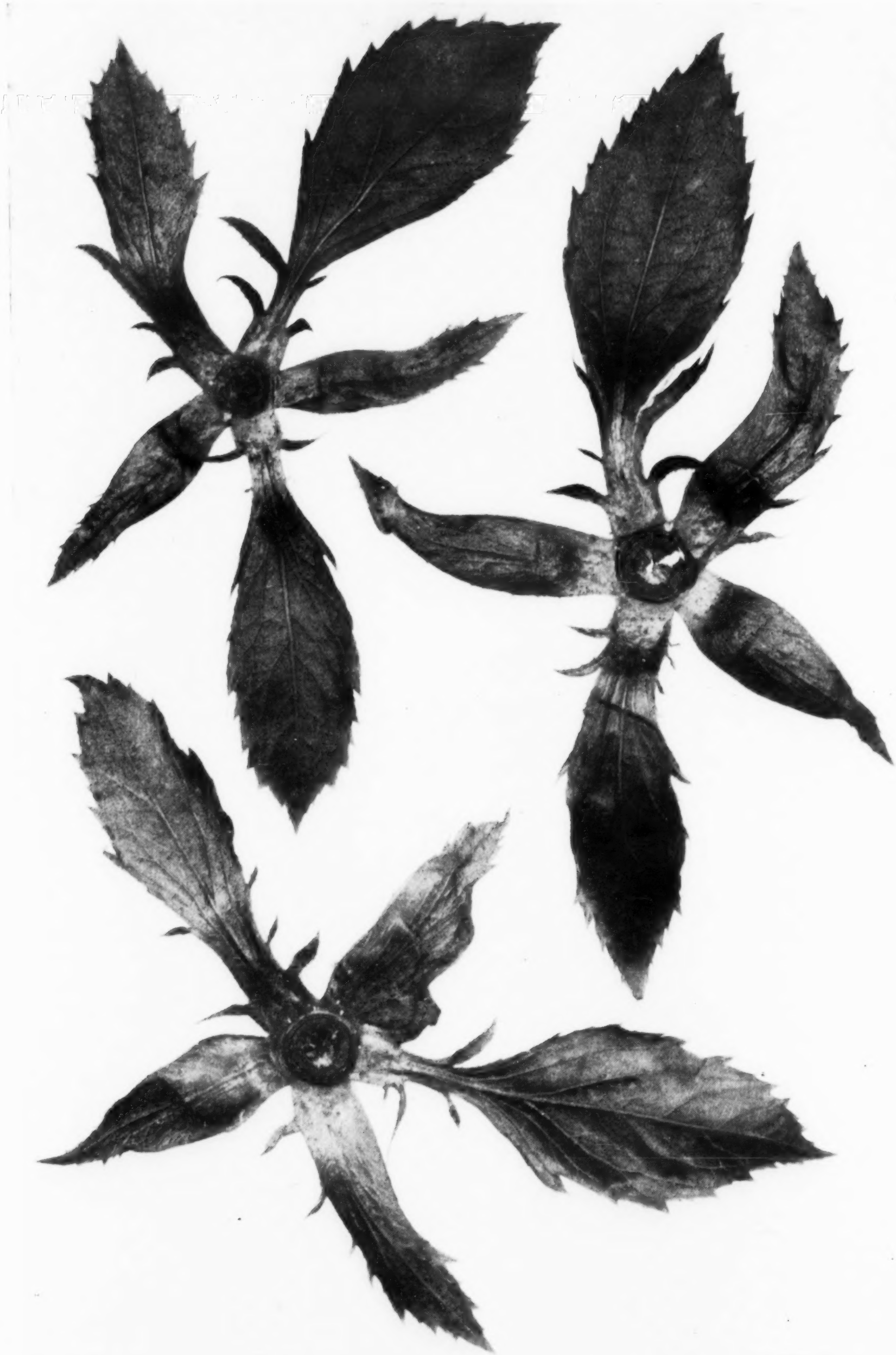
To appreciate that there is a regular sequence of reduction in the metaphanic sepals, account must be taken of the morphological fact that the leaves of plants are arranged generally in spirals, and that the spiral arrangement continues among the sepals as corresponding to leaves of successive internodes of the branch. The internodes between the leaves may be so shortened or suppressed that the leaves or corresponding organs appear as a circle of "whorl" is in a calyx, corolla, or involucre, but the members of such whorls still represent structural successions, as may be seen in these metaphanic sepals.

Considering the largest sepal as the lowest of its whorl, the relation with the other sepals appears quite regular. In each case the sepal next in size is nearly opposite to the largest sepal, while the third sepal in size has a similar relation to the second sepal. The smaller sepal that projects between the first and second is the fourth sepal of the spiral series, while the fifth sepal stands between the second and third. To reach the five sepals in the order of reduction in size, two turns around the center are indicated corresponding to a 2/5 spiral of normal phyllotaxy.

Enlargement of Stipules

In comparison with the two subfloral leaves of Figure 11, the enlargement of the stipules of the metaphanic sepals is a striking feature, especially in the large calyx of Figure 10, where the stipules not only are very large but are strongly curved.

An explanation of the enlarged stipules may be found in the stipular nature of the sepals, meaning that the normal sepals correspond morphologically to the foot or stipular portion of the normal leaf with the blade of the leaf suppressed, or reduced to a minute apical appendage. Thus the enlargement of the stipules in the metaphanic sepals is to be taken as representing a stage in the normal transformation from the foliage leaf to the stipular



REDUPLICATION OF STIPULES

Figure 12

Many of the metaphanic sepals have three pairs of stipule-like organs, the lowest pair corresponding to the normal stipules and other pairs representing the lateral pinnae of the normal foliage leaves. Observe that in each calyx one of the sepals, which is the middle member of the series, has stipules distinct on one side, while the other side is without stipules. (Natural size.)

GRADUAL CHANGES OF CHARACTERS

Figure 13

Reduction of leaves to bracts showing gradual stages of enlargement of the foot or stipular element of the leaf and of suppression of the blade element, to form the small sepal-like bracts that are found below the calyx in some varieties of roses. The gradual reduction of the leaves, even in advance of the formation of the stipules, is in contrast with the abrupt change of characters shown in Figure 11. (Natural size.)

form that is reached in the normal sepal.

Reduplication of Stipules

Another feature of the metaphanic rose sepals is that some of them show distinctly two or three pairs of stipules, or of stipule-like organs, in some cases so closely alike that their morphological equivalence would hardly be questioned. The intermediate stages indicate that the lower pair of these structures corresponds to those that function usually as stipules, while the upper pairs correspond to the pinnae of the compound leaves.

Thus an indication is afforded that the compound leaves of the rose family have developed by reduplication of the foot or stipular element, as already indicated for the leaves of the walnut family, in the JOURNAL OF HEREDITY for May, 1923. The rose family retains the first pair as stipules at the base of the leaves, while in the walnut family the stipules have become obsolete in the foliage leaves, though still appearing in the bud-scales. In these groups it appears that the lateral pinnae of compound leaves correspond morphologically to the stipules of simple leaves, instead of the compound leaf type having been developed through subdivision of simple leaves. But compound leaves in other families may have followed other courses of development.

Middle Sepals Unsymmetric

It is worthy of note that the third sepal of each calyx is usually unsymmetrical. As the photographs show, the stipules are distinct on one side of the third sepal, but on the other side are completely suppressed. This seems to be true in all cases where the stipular elements are developed as separate lateral appendages. Thus with respect to the stipules, each series of five sepals divides exactly in the middle. Two of the sepals have the stipules distinct, two have the stipules completely fused, and the middle sepal has the stipular element separate on one side and fused on the other. In all cases the appendages are found on the side that is lower down on the spiral of the phyllotaxy, in the direction of the sepals with the free stipules.

With the sepals differing so much in size, as shown by the photographs, it seems the more remarkable that the change from separate to suppressed stipules should appear so definite, and that it should take place at the middle point of the series of five sepals in each calyx. That this specialization is so definitely established may be connected with the overlapping of the sepals in the bud, so that the third sepal is exposed on the lower side and covered on the upper side, although the presence or absence of the separate stipules undoubtedly is determined at a very early stage of development, far in advance of the difference of exposure.

Although the reduction in size of the sepals is gradual, the suppression of the stipules, or fusion with the foot element, still appears as an abrupt or definitely contrasted character. The facts might be interpreted by supposing that the lower sepals have been replaced by leaves of gradually reduced sizes, but on this basis the middle member of each calyx would need to be reckoned as a composite structure or chimera—leaf on one side and sepal on the other. Such chimeras do occur, and may be taken as further examples of abrupt changes of characters in the course of development, changes so abrupt that the transition occurs during the formation of a metamer, rather than between metamers.

One of the sepals of the calyx at the bottom of Figure 12 shows a chimaeroid anticipation of petal characters, in the lobe-like expansion of the base on one side, which had the texture and color of a petal. It is notable that this variation occurred in the fourth sepal of the series, and that the fifth sepal was normal. Thus there was only a transitory deviation, as though the petal characters were switched temporarily into expression when the rudiment of this particular sepal was formed.

Variations like Chimeras

The distinction between a metaphanic chimera and other metaphanic variations would lie chiefly in the abruptness of the change of characters. A transition may be so gradual as to cover the formation of several intermediate metamers, or may be so abrupt as to occur at a definite point in the formation of a single organ. While the internodes are individuals, they are not completely autonomous, since they are subject to changes of characters, even after their development has begun. The change from leaf to sepal, as shown in Figure 11 still is an abrupt change, notwithstanding the unusual enlargement of the lower sepals, while the changes shown in Figure 13 are much more gradual.

Examples of more abrupt metaphanic variations of stamens, petals and sepals were found together on a tree of "Texas Prolific" almond, at Sacaton, Arizona, March 6, 1921. Some of the stamens were expanded to form supernumerary petals, some of the petals showed sepal characters, and some of the sepals showed petal characters, either in median segments of the organs or on one side. Several of the metaphanic petals had midribs of thickened deep purple or green tissue pubescent on the back like the sepals, and these modified petals persisted like the sepals after the normal petals had fallen. Some of the metaphanic sepals had a large wedge-shaped petaloid expansion in the middle, while the lateral segments of the same organs showed normal sepal characters.

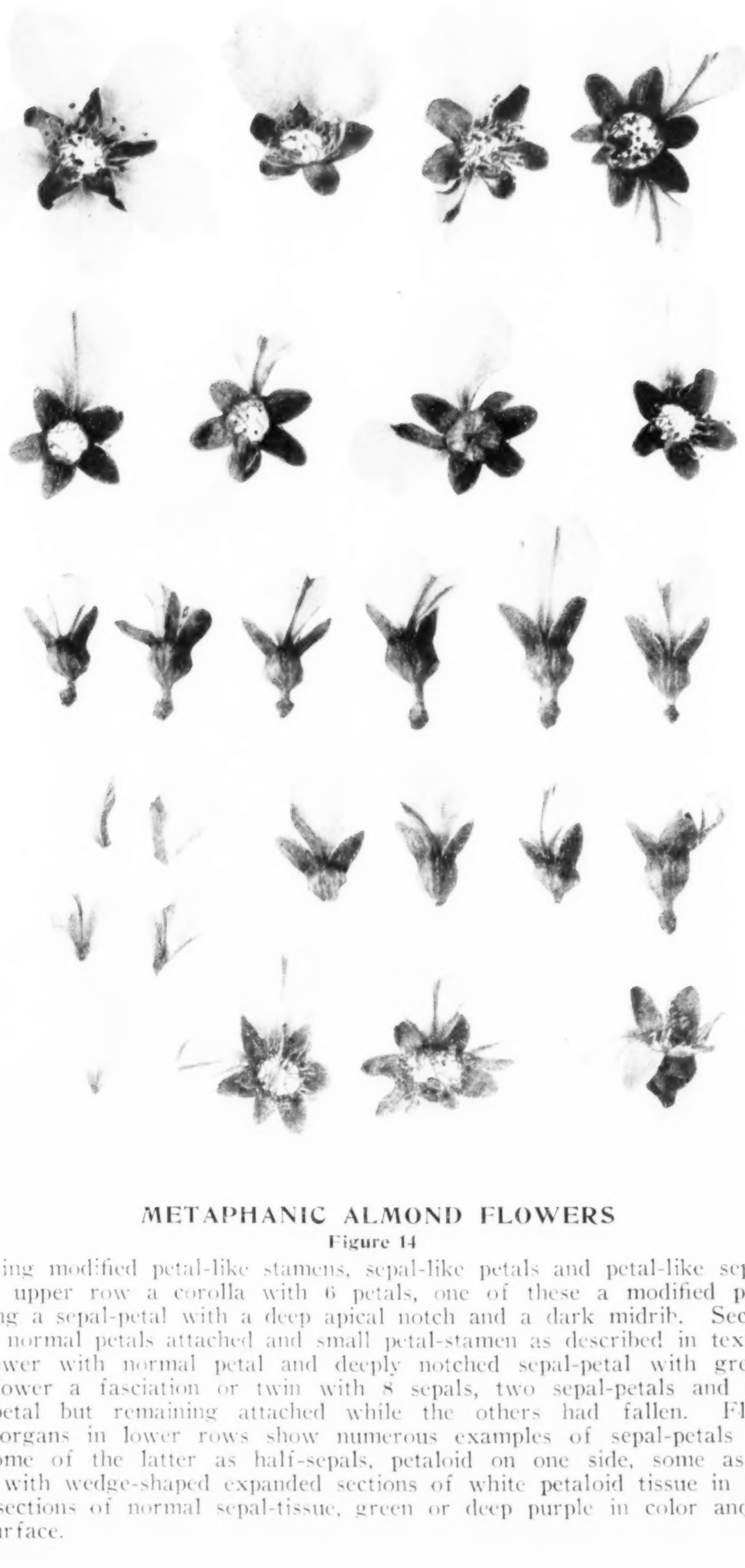
One of the modified stamens had a rather narrow, contorted, petaloid white blade on one side, while the other side was represented by a small, yellow abortive anther cell attached at the same elevation as the anthers of the normal stamens, not at the end of the blade, but at the end of a shorter thickened margin that doubtless represented one side of the filament of a normal anther. This abnormal petal-stamen is a chimera, half petal and half stamen but both halves with modified intermediate expression of the characters. Such an abnormality suggests that the expanded portion of the petal corresponds to the anther of the stamen while the narrow base or petal-claw corresponds to the filament. Also the occurence of metaphanic variations of the three organs together is interesting as a suggestion of homology and possible derivation of all of the expanded organs, petals, sepals and leaves, by a process of sterilization of stamens.

Expression Relations of Characters

From the facts of metaphanic variation it is plain that the characters may be studied in other relations than those of transmission, seeing that plants with the same content of transmission may still develop quite differently. Differences may be shown not only in size or in other direct effects of the environment, but also in the sequence of development of the various kinds of metamers and in the transitions from one type of metamer to another. To know how these expression-relations are modified by the conditions of existence may be just as important as to know how characters are transmitted.

How the characters are represented in the germinal material is still obscure. To determine that the characters are represented in the chromosomes is a remarkable advance of scientific knowledge, but does not give us functional ideas of the nature of the characters or of their relations to each other in the sequence of development, or in the course of evolution.

Since many characters may be transmitted without being brought into expression, the expression-relations must be considered even for an understanding of transmission. Differences of expression-relations are recognized in cases of dominant and recessive characters, but these have a wider significance in the field of development and in the study of evolution. Apparently it is necessary to work from the side of expression to gain more concrete ideas



METAPHANIC ALMOND FLOWERS

Figure 14

Showing modified petal-like stamens, sepal-like petals and petal-like sepals. First flower in upper row a corolla with 6 petals, one of these a modified petal-stamen overlapping a sepal-petal with a deep apical notch and a dark midrib. Second flower with two normal petals attached and small petal-stamen as described in text (p. 421). Third flower with normal petal and deeply notched sepal-petal with green midrib. Fourth flower a fasciation or twin with 8 sepals, two sepal-petals and one nearly normal petal but remaining attached while the others had fallen. Flowers and separate organs in lower rows show numerous examples of sepal-petals and petal-sepals, some of the latter as half-sepals, petaloid on one side, some as segmental chimeras with wedge-shaped expanded sections of white petaloid tissue in the middle, between sections of normal sepal-tissue, green or deep purple in color and pubescent on the surface.

ENLARGED VIEWS OF ALMOND FLOWERS

Figure 15

Enlarged views of some of the flowers shown in Figure 14, showing in greater detail some of the metaphanic variations. Normal petals and sepals are shown, and forms suggesting sepal-petal chimaeras. Such "inter-organ hybrids" between petals and sepals are good examples of metaphany, a type of variation possibly of great evolutionary significance. The difference in these parts must be assumed to be due to differences in expression, rather than to differences in heredity, and the ability to form such intermediate variations may afford the organism a certain latitude of experiment in making adjustments to the environment.

of the nature of the characters, and of their relations to each other. The metaphanic variations are not to be explained merely by saying that they are due to misplacement or "translocation" of the characters. The idea of translocation is misleading, as tending to associate the phenomena with the transmission of characters, instead of recognizing that the expression is changed, rather than transmission.

It is significant that the characters are changed in the course of plant development, so that the process of development is a more or less definite sequence of changes of characters. The changes of characters that appear in successive metamers are the phenomenon that led Goethe to recognize the "metamorphosis" of plants. Goethe saw clearly that the internode individuals were structural equivalents, and became convinced that the differences which had developed between the different kinds of internodes were essentially of the same nature as the differences between species.

These analogies are definitely stated in Goethe's prose writings as well as in his poem on plant evolution, but such morphological conceptions were not understood by Goethe's literary commentators, and even among present-day biologists are strangely overlooked. No better evidence or illustration of evolution has been presented by later writers on the subject.

The Problem of New Characters

One of the difficult problems of heredity and evolution is to understand how new characters originate. In this direction little progress seems to have been made. The more accustomed we are to think of heredity as a definite mechanism for repeating the same characters in each generation, the more difficult it is to entertain the idea of suddenly implanting a new character, to say nothing of adding several new characters at once, as assumed by those who believe in abrupt transformation into new species.

The idea of defect or derangement of characters, or of characters failing to come into expression, is well established among students of genetics, and undoubtedly applies to many variations of the mutative, Mendelizing type, but it does not account for new characters.

Variations occur in all groups of organisms, and have been studied extensively, but with no agreement among specialists as to which classes of variations contribute to evolution. Although the general idea of evolution is accepted by most biologists, the lack of a clear understanding of the nature of the evolutionary process leaves the question still in debate. It is easier to elaborate arguments about evolution than to become familiar with the facts and difficulties of the problem.

Darwin found reasons for believing in very slow and gradual changes of characters, and ascribed such changes to the influence of natural selection in accumulating slight, imperceptible differences through long periods of time. But this Darwinian theory, that selection is the cause of evolution, though still credited by many, is held less firmly and may be abandoned entirely.

Experiments have not shown that selection has any power to induce variation or to bring about the formation of new characters. Evolution is a creative process while selection is a process of elimination. Selection functions as a "safe-guarding principle," by weeding out the defective and inferior that otherwise might hamper or restrict the evolution of the species, but selection does nothing to the survivors, to cause them to change, or to induce changes in their offspring.

It is easy to see that selection may prevent or deflect evolution, if some variations are removed while others are retained, but this affords no basis for the assumption that selection is an actuating cause of changes that go on. The whole argument for and against materialism, elaborated on both sides from the assumption of an environmental cause of evolution, is irrelevant. Evolution does not depend upon selec-

tion or other environmental causes. The evidence that bears upon this question tends to show that evolutionary changes of characters are spontaneous within the species, so that each species can evolve independently, in the direction of adaptive or non-adaptive variations.*

Abrupt and striking differences appear among the members of species, and many biologists are still engaged with the idea that such saltatory variations or "mutations," as they are now called, are the means of changing one species into another. Darwin studied many of the abrupt variations, or "sports" but considered them as abnormalities rather than as constructive steps in evolution. It remained for Professor de Vries to rehabilitate the idea of sudden changes of characters as giving rise to new species. Interesting facts were presented and many readers were convinced, but no general acceptance of the transformation theory is now expected.

The emphasis placed by Darwin and de Vries on the origination of new species is misleading, since the differentiation of species is not necessarily connected with the formation of new characters. Species may be separated without producing new characters, or new characters may be established in a species without any subdivision of the group taking place. Changes of the characters of a species may be more significant from the standpoint of evolutionary progress than a separation into a larger number of species.*

It seems remarkable that so many attempts have been made to explain evolution without a preliminary effort to gain clear conceptions of the nature of evolution, as a process of change in the characters of species. The species as they exist in nature, not only must be considered as products of evolution, but also as showing the condition in which evolution takes place. In other words, the nature of species affords the best indication of the nature of evolution.

For the purposes of evolution and heredity it should be recognized that the natural species is a group of diverse individuals united by interbreeding into a continuous network of descent. It is in such groups of organisms that evolutionary progress must be supposed to take place, rather than in uniform, "pure-line" groups which many writers have assumed to be species.

The study of metaphanic variations may help us to understand how some of the mutative diversities among the members of species may contribute to evolution, though most of the abrupt changes of characters are abnormal, as Darwin recognized. Indications are afforded by the metaphanic characters that wide changes of external features may result from extremely slight changes of the internal mechanism of heredity. It need not be supposed that the transmission of the characters is changed, but only that the expression of the characters is modified, so that the extent or sequence of development is affected.

The same inference regarding variations as changes of expression could be drawn from the many cases where widely different species and even genera are still able to hybridize, and from the many cases where the adult characters of some species appear as juvenile characters of related species. Thus it appears that many of the differences between species are of the same nature as the diversities that are found among members of the same species, and also are like the variations that occur in equivalent parts of the same organism.

*Evolutionary Inferences from the Diplopode, *Proc. Entomological Society of Washington*, 5:84, 1902. Aspects of Kinetic Evolution, *Proc. Washington Academy of Sciences*, Vol. VIII, pp. 197-403, 1907. New Tropical Millipeds of the Order Merocheta, with an Example of Kinetic Evolution, *Proc. U. S. National Museum*, 40:451, 1911.

*Evolution not the Origin of Species, *Popular Science Monthly*, March, 1904; Factors of Species-Formation, *Science*, March 30, 1906; Evolution without Isolation, *American Naturalist*, 42:727, November, 1908.

Three kinds of variations, specific, heteristic and metaphanic, may be considered as changes of the expression-relations of the characters, without supposing that the transmission of the characters has been changed.

Instead of such differences of expression being too small to be perceived readily, the difficulty is rather that they are so numerous and versatile as to seem intangible, so that it has been possible for Darwin and many other writers to confuse the normal genetic diversity, or heterism, of species with fluctuations in size and other responses to environmental conditions.

That some of the metaphanic variations may be called forth by special environmental conditions does not render them of less interest in heredity and evolution, but rather of more interest. Liability to deviations in development is a quality of the hereditary constitution, in contrast with greater regularity of expression of other characters, or in other lines of descent. Though many of the more striking metphanic variations are obviously abnormal, some may not be defective, or may be of value as adaptations, so that they would be favored by selection and become established in the species. How many of the heredity variations can be interpreted as metaphanic, or due to modified expressions of the characters, remains to be determined.

Germ Cells and Body Cells

KORPER UND KEIMZELLEN, *by* J. W. HARMS. 2 vols., pp. 1023, price M.33. Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere 9te Band, 1, und 2. Teile, Berlin, Verlag von Julius Springer, 1926.

This is an encylopedic work on a subject of the greatest interest to every student of genetics, by a professor in the University of Tübingen. It reviews, in the light of the literature and the author's own researches, the nature and history of the germ cells and all their interrelations with the body. Most of the second volume is given over to a discussion of the various methods of supposed rejuvenation, ending with a bibliography of 50 pages.

P. P.

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NEWS AND NOTES

Death of Frederick M. Berthrong

WITH great regret we announce the death of the Treasurer of the American Genetic Association, Mr. Frederick M. Berthrong, which occured on November 24 at Mayo Clinic Hospital, Rochester, Minnesota.

Mr. Berthrong had been Treasurer of the Association for only a short time. His primary interest was in financial matters, but he took great interest in the work of the Association. In his death we lose a true friend and a devoted officer.

Mr. Berthrong was born in Washington in 1886 and lived there all his life. He spent many years in the service of the Washington Loan and Trust Company rising to the position of Assistant Treasurer. Last January he accepted the position of Assistant Treasurer of the National Geographic Society. He was also treasurer of the Volta Bureau, founded by Alexander Graham Bell to promote the teaching of the deaf, and of the Wesley Methodist Episcopal Church.

Mr. Berthrong is survived by his wife and three sons, and by his father and mother.

Mississippians in Who's Who

ONLY three per cent of the white male Mississippians listed in "Who's Who in America" are single, 90 per cent have been married once, 5 per cent married twice or more, and a few do not state whether they are married or not, according to Dr. R. M. Harper, geographer and statistician of Florida, who has been making a study of Mississippi.

In 1920, the year of the latest census, there were 174 natives and 86 residents of Mississippi listed in Who's Who, the statistician said. The number, he added, has increased a little since then, but the ratio of Who's Who people to population probably has not changed materially in the last few years.

The 174 natives include ten women and about a half-dozen negroes. About one in every 10,000 white residents and one in every 6,000 white natives of Mississippi living in the United States, is listed in Who's Who.

The average age of those born in Mississippi who are listed in this group is about 54 years. The average age of first marriage of the men who have married is about 28 years, or four years later than the aggregate white male population of the state.

"It is a curious fact that practically every county or city which has produced more than its share of noted persons has long had more women than men in its population," Dr. Harper said. "Not only in Mississippi but in other states, I have discovered the same condition."

Only one-fourth of the distinguished people born in Mississippi now live in the state, according to the statistician.

"Doubtless because such persons tend to congregate in cities, and Mississippi is an agricultural state, not so well supplied with cities as most other states," he said. "Of these who have gone elsewhere to seek fame and fortune the largest number have gone to the District of Columbia for government service. Next in order are Tennessee, Texas, New York, Arkansas, Illinois, Kentucky, Louisiana, Oklahoma, and Pennsylvania. The migration of noted persons has evidently

been more northward than westward, while the main stream of white migration has been westward, to Texas, Louisiana, and Arkansas, with smaller numbers to Tennessee, Alabama, Oklahoma and all other states.

"By occupation about 15 per cent of the white men born in Mississippi are lawyers. Congressmen (including senators) are a close second, and next are educators, public officials, clergymen, judges, army officers, physicians and bankers. Several Mississippians have become governors and high officials of other states.

Associated Press dispatch, corrected.

Fur Sheep in the United States

AFTER some delay, the proceedings of the first meeting of the American National Karakul Breeders Association have been published, and a copy of this booklet has recently come to hand. The meeting was held at Denver, Colorado, January 25, 1923, having been called by the Secretary of the American National Livestock Association. Of especial interest is an address by Dr. C. C. Young, giving the history of his efforts to introduce the Karakul sheep from Asitic Russia. From time to time the Journal has published articles by Dr. Young on various phases of his Karakul explorations and investigations. This address serves to fill in the gaps of the story as it has been told in the Journal.

As far as an outsider can gather from this discussion, the point at issue between the two Karakul Registry Associations now in existance in the United States is "What is a Karakul Sheep?" The object of breeding fur sheep is to obtain the highly prized pelts of the young lambs. As it is usually used, there is a difference of opinion as to whether the term "breed" can yet be applied to Karakul sheep. Not only are there great anatomical differences between the sheep, but even more important, they differ greatly in their ability to produce offspring having the desirable tightly curled black fur. Variation in quality of fur produced is the important point, and there seems to be need of more information relative to the anatomical differences that are or may be correlated with the fur characteristics.

When strains have been bred up to the point of yielding a large percentage of acceptible skins there should be justification for calling such strains pure-bred Karakuls. The sheep might be very diverse in other characteristics, but in this one respect the breeding test should have demonstrated their uniformity. Then as the breed multiplies, selection for other characters might be undertaken.

It seems very desirable that more genetic data be obtained about the inheritance of wool characters in these sheep. For example, it is said that rams very unpromising as individuals occasionally sire high grade lambs. This may indicate recessive factors or multiple factor inheritance—a situation by no means as simple as some writers have supposed. Such animals might carry factors that would be of the utmost value in the development of the breed, but at present we do not know whether saving these rams would be justified.

The Children's Bureau on Crime

STUDY by the Federal Government of the causes and prevention of delinquency and crime in children and young persons is recommended by Grace Abbott, Chief of the Children's Bureau of the United States Department of Labor, in her annual report made public December 14.

"Crime begins in delinquency among children," Miss Abbott states. "Though the sensational statements about increase in crime are not justified by the

evidence available, no one would deny that the facts justify the demand for scientific study of methods of prevention. The requests which come to the Children's Bureau for research in this field and for consultation with local agencies cannot be met with the present appropriation.

"To meet the present need a division in the Children's Bureau devoted entirely to juvenile delinquency and having the necessary social investigators, psychiatrists and psychologists should be created. This would require an annual appropriation of approximately $50,000. Such an expenditure would be in the interest of national economy. At present we pay too much for the care and punishment of criminals and too little for the prevention of crime."

There are no National statistics on juvenile delinquency in the United States similar to the statistics on births and deaths, Miss Abbott pointed out. The Children's Bureau has developed a plan for uniform reporting by juvenile courts on cases handled by them. In this way it is hoped to learn at least the extent of the problem as it is handled through children's courts.

California University Graduates' Families

IN an article on the Harvard Birth Rate published in the August issue of this journal I am cited as stating that the graduates of the University of California have an average of 3.25 children per married couple. Unfortunately, the author mistook my meaning. My studies were concerned with the number of children in the families of the parents of college students, not with the number of children in the families of our graduates. The figure 3.25 represents the size of the family among parents one or both of whom attended college. As it obviously does not include families with no children it cannot be taken as indicating the probable family size among college graduates in general. One cannot conclude, therefore, that our graduates "are probably maintaining themselves." All the data indicate that they fall considerably below this reproduction level like the graduates of Harvard.

—*S. J. Holmes.*

Fifth International Conference on Genetics

Berlin, September 11th-18th 1927

THE International Committee for arranging the next Conference on Genetics having decided, unanimously, to accept the invitation of the German Society for the study of Genetics, the next Conference will be held in Berlin in 1927, from September 11th to September 18th.

The Conference will be completely International in character. German, English and French will be the spoken languages. At the first session of the Conference permission to use other languages will be considered and decided upon.

It is proposed that each of the six morning sessions shall be opened by an address from some leading authority, giving a comprehensive account of the present condition and future outlook of his special branch of research. The choice of lecturer and subject are, at present, still under consideration. The sessions will serve further for communications and papers on important research and experiment. It will be necessary to limit the delivery of these papers to 20 or 30 minutes.

Microscopes, lantern, etc., will be provided for the exhibition of illustrations.

Membership of the Conference may be obtained by ticket, price 15 RM. The Transactions of the Conference will be printed and offered to Members for 30 RM.

For the last day an excursion to Potsdam, closing with a grand banquet, has been planned. This excursion and banquet are included in the price of Membership ticket.

After the conclusion of the Conference there will be longer excursions to Halle, and to some of the Plant-Breeding centers.

A precise programme and a list of the papers to be laid before the Conference will be issued later.

Rains Remove Twenty Times as Much Plant Food as Crops

In connection with the Honey Locust Contest which was announced in the July JOURNAL, *the following note from the United States Department of Agriculture is of unusual interest. The need for tree agriculture is very real in some parts of the United States.*—EDITOR.

OLD mother earth's annual bathing bill costs the farmers of the United states more than $200,000,000 every year. Rain water scouring the countryside, rushing down hillsides, gouging out gullies, and sweeping over gentle slopes of cultivated fields, carries away to the ocean many millions of tons of soil. With this rich topsoil goes 126,000,000,000 pounds of plant-food material—lost to the farmers of the country forever—twenty times the amount permanently removed by cropping.

But this is only a fraction of the damage wrought, says H. H. Bennett, soil scientist of the United States Department of Agriculture. The real scourge of erosion is that it takes not only the elements of plant food but soil—plant-food material and all—leaving in many instances infertile material very difficult to till. Erosion is constantly shaving off the topsoil of cultivated fields—the richest soil of the land. In one instance it was found that 7 inches of topsoil were removed by sheet erosion in 24 years from a gently sloping field of Putnam silt loam growing corn under ordinary cultivation in Missouri. Soil scientists agree that most of the worn-out lands of the world are in their present condition because much of the surface has been washed away, and not because they have been worn out by cropping.

A single county in the Piedmont region was found by actual survey to contain 90,000 acres of land formerly productive but now permanently ruined by erosion. Another county in the Atlantic coastal plain has 60,000 acres of land in the United States formerly cultivated has been permanently destroyed by rainwash. Much of this could have been saved by timely terracing.

There is need at once for a nation-wide awakening to the evils of erosion, says Mr. Bennett. There is immediate need also for fundamental soil data relating to erosion; demonstrations of the value of properly built terraces; and much national education about this menacing agency of land devastation.

Errors in October Journal

The horse shown on the cover of the October JOURNAL was Leopard, not Linden Tree, as was stated. He was correctly named on page 354.

In the announcement on the results of the 1926 Endurance Rides on page 388, "Tomahawk's" score should have been 95.2 points, not 55.2 points as it appears in the text.